

location estimators perform at least two of the following techniques (i), (ii), (iii) and (iv):

- 15 (i) a first technique for estimating locations of said mobile stations, wherein for each mobile station MS1 of at least some of the mobile stations, the first technique estimates a location of MS1 using signal time delay values from a first corresponding portion of said input data obtained from signals received at the mobile station MS1
- 20 from one or more satellites, wherein said first technique uses said signal time delay values for determining one or more distances between said mobile station MS1 and said one or more satellites;
- 25 (ii) a second technique for recognizing a pattern of characteristics of a second corresponding portion of said input data, wherein said second technique uses an association for associating, for each of a plurality of mobile station locations, multipath wireless signal characteristics between: (a) one or more of the communication stations, and (b) one of the mobile stations at the location; and
- 30 (iii) a third technique for determining locations of said mobile stations, wherein for each mobile station MS3 of at least some of the mobile stations, and for at least a corresponding one of the communication stations CS that is responsive to transmissions from the mobile station MS3 [], one of (a) and (b) following is determined
- 35 at a site remote from the mobile station MS3: (a) a distance between the communication station CS and the mobile station MS3, said distance dependent upon measurements of a time delay of signals transmitted between the mobile station MS3 and the communication station CS, said measurements obtained from a third corresponding portion of said input data, and (b) a wireless signal angle of arrival
- 40 indicative of an angular orientation about the communication station CS of a direction of the wireless transmissions to CS from MS3;

121. (Twice Amended) A method for locating a wireless mobile station capable of wireless two way communication with a plurality of fixed location terrestrial stations, comprising:

providing access to a plurality of mobile station location estimators, wherein said

5 location estimators provide location estimates of said mobile station when said location estimators are supplied with corresponding input information upon which their location estimates are dependent, and wherein the corresponding input information is at least partially derived from wireless signal measurements transmitted from or received at the mobile station;

10 receiving, over time, a plurality of location estimates of the mobile station, wherein said step of receiving includes steps (a) and (b) following:

EL9
Cont
15 (a) first receiving, from a first of said location estimators, a first one or more location estimates of the mobile station, wherein said corresponding input information for said first location estimator includes timing data from wireless signals transmitted from one or more global positioning satellites, and received by the mobile station;

20 (b) second receiving, from a second of said location estimators, a second one or more location estimates of the mobile station, wherein said corresponding input information for said second location estimator includes data that is a function of a signal time delay of wireless signals transmitted between the wireless mobile station and one of said plurality of fixed location terrestrial stations during a plurality of transmissions between the mobile station and the one terrestrial station wherein there is at least one transmission from the mobile station to the one terrestrial station, and at least one transmission from
25 the one terrestrial station to the mobile station, and wherein said second one or more location estimates are determined by said second location estimator at a terrestrial site whose location is independent of a movement of the mobile station;

30 determining, a plurality of consecutive resulting location estimates for tracking the mobile station, wherein said step of determining includes: (a) deriving at least one

219
Conrad

of said resulting location estimates of the mobile station using a location estimate most recently generated from one of said first one or more location estimates by said first location estimator, and (b) deriving at least one of said resulting location estimates of the mobile station using a most recently generated one of said second one or more location estimates by said second location estimator.

126. (Twice Amended) A method for providing a location estimate of a wireless mobile station using measurements of wireless signals, comprising:

first transmitting, when available, a first collection of measurements of wireless signals transmitted between said mobile station and one or more satellites, to a first location estimator;

second transmitting, to a second location estimator remote from and independent of a movement of the mobile station, a second collection of measurements obtained from wireless signals transmitted between said mobile station and one or more fixed location terrestrial stations, at least when said first collection is not available, wherein said second collection includes signal time delay data of wireless signals transmitted between the mobile station and the fixed location terrestrial stations;

wherein said second location estimator determines a location estimate of the mobile station dependent upon the mobile station being approximately on a locus of locations from at least one of the fixed location terrestrial stations, said locus

including substantially only locations where a signal time delay dependent condition is satisfied using the signal time delay data;

first obtaining a first location estimate of said mobile station when said first location estimator is supplied with an instance of said first collection;

second obtaining a second location estimate of said mobile station when said second location estimator is supplied with an instance of said second collection;

outputting a resulting location estimate that is dependent upon at least one of said first and second location estimates.

133. (Twice Amended) A method for locating a mobile station when there is an occurrence of at least one of: said mobile station being tracked, and a request for locating said mobile station, wherein said method uses wireless signal measurements obtained from transmissions between said mobile station and a plurality of fixed location communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly communicating with said mobile station, comprising:

providing access to first and second mobile station location evaluators, wherein said location evaluators determine information related to one or more location estimates of said mobile station when said location estimators are supplied with data having values obtained using wireless signals obtained via transmissions between said mobile station and the communication stations, wherein (A) and (B) following:

(A) said first location evaluator performs one or more of the following techniques (i), (ii) and (iii) when supplied with corresponding instances of said data:

(i) a first technique for estimating a location of said mobile station by using [to determine] a wireless signal angle of arrival between the mobile station and at least one of the communication stations CS, wherein the wireless signal angle of arrival identifies a direction for the mobile station from CS;

(ii) a second technique for estimating a location of said mobile station using values from a corresponding instance of said data obtained from timing signals received at the mobile station from one or more satellites;

(iii) a third technique, wherein said third technique uses a statistical correlation for correlating (a) and (b) following:

(a) wireless signal related values of a corresponding instance of said data instance; and

(b) information indicative of a location for the mobile station, wherein said correlation is used for determining a probability that the mobile station is within at least one geographical area, and

30 (B) for said one or more of said techniques performed by said first location estimator, said second location estimator performs a different combination of said one or more of said techniques when said second location estimator is supplied with corresponding instances of data for the one or more techniques of said different combination;

35 first obtaining from said first location estimator, first location related information of the mobile station's location; for said occurrence, using when available first corresponding instances of said data for each of said one or more said techniques performed by said first location estimator;

40 second obtaining from said second location estimator, second location related information of the mobile station's location, for said at least one occurrence, using when available second corresponding instances of said data for said different combination;

45 wherein each of said first and second location related information is capable of being generated independently of the other of said first and second location related information;

determining a resulting location estimate of the mobile station using at least one of (a) and (b) following: (a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information;

50 wherein said step of determining includes a step of identifying one or more subareas for said resulting location, said one or more subareas selected from a predetermined plurality of subareas of a larger mapped area.

134. (Twice Amended) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and a plurality of terrestrial communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly

5 communicating with said mobile station, comprising:

receiving a request for a location of the mobile station;

generating one or more requests for information related to a location of said mobile station for supplying to [from] one or more mobile station location evaluators such that when said location estimators are supplied with corresponding input data
10 having values obtained from wireless signal measurements obtained via transmissions between said mobile station and the communication stations, said one or more location evaluators perform at least two of the following techniques (i), (ii), (iii) and (iv) when said techniques are supplied with a corresponding portion of said data:

(i) a first technique for determining at least one location area or locus for
15 said mobile station by triangulation or trilateration using corresponding input data having timing measurements indicative of one of: a time of arrival of wireless signals; and a time difference of arrival of wireless signals between the mobile station and at least one communication station CS, wherein the signals for obtaining the timing measurements are communicated during a
20 plurality of wireless signal transmissions between the mobile station and CS, with at least one of the transmissions being from the mobile station to CS, and wherein said first technique outputs the at least one location area or locus from a site different from the location of the mobile station;

(ii) a second technique for determining one or more candidate locations of the mobile station, wherein each of said candidate locations is determined
25 using, for at least some one of the communication stations CS, corresponding input data for a wireless signal angle of arrival that is indicative of an angular orientation about [at least one communication station] CS of a direction of the wireless signal to CS from the mobile

30

station, wherein when one or more instances of said first technique are performed by said location evaluators, for at least one of the instances, the results therefrom do not substantially affect the determination of the MS candidate locations;

35

(iii) a third technique for estimating a location of said mobile station, using timing values from a corresponding portion of said data obtained from signals received at the mobile station from one or more satellites;

40

(iv) a fourth technique, wherein said fourth technique provides a pattern recognizer for estimating a location of said mobile station by deriving said location estimate from a pattern of multipath wireless signal characteristics between: (a) one or more of the communication stations, and (b) said mobile station;

first obtaining, from said one or more location estimators, a first one or more location estimates using an available first one or more corresponding portions of said data;

45

determining a resulting location estimate of the mobile station obtained from at least one of said first one or more location estimates;

50

wherein at least one of said steps of receiving, generating, first obtaining, and determining include a substep of one of: (i) transmitting information to a predetermined destination using one of a public switched network and the Internet, and (ii) receiving information from a predetermined source using one of a public switched network and the Internet.

137. (Twice Amended) A method for locating a mobile station when there is at least one occurrence of: said mobile station being tracked, and a request for locating said mobile station, wherein said method uses wireless signal measurements obtained from transmissions between said mobile station and a plurality of fixed location communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly communicating with said mobile station, comprising:

providing first and second mobile station location evaluators, wherein each of said location evaluators determine location information having [related to] one or more location estimates of said mobile station when said location estimator[s are] is supplied with data having values obtained from wireless signal measurements obtained via transmissions between said mobile station and the communication stations, wherein (A) and (B) following:

(A) said first location evaluator performs one or more of the following techniques (i), (ii), (iii) and (iv) when said techniques are supplied with a corresponding instance of said data:

(i) a first technique for determining a first instance of the location information from a two way communication between the mobile station and at least one of the communication stations CS, [,] wherein one of: a wireless signal angle of arrival, and a time difference of arrival between the mobile station and the at least one communication station is used in determining said first instance, and wherein said first instance is determined remotely from the mobile station;

(ii) a second technique for estimating a location of said mobile station, using timing values from a corresponding instance of said data obtained from signals received at the mobile station from one or more satellites;

30 (iii) a third technique for recognizing multipath characteristics from
a corresponding instance of said data, wherein said third technique
includes the steps of (a) and (b) following:

- 35 (a) calibrating, for each of a plurality geographical locations, (a1)
and (a2) following: (a1) a representation of the geographical
location, and (a2) for the geographical location, corresponding
multipath information indicative of multipath signals
previously transmitted between some mobile station and the
communication stations, when the some mobile station
transmitted from approximately the geographical location;
- 40 (b) determining one or more likely location estimates for the
mobile station from a similarity between (b1) and (b2)
following: (b1) multipath characteristics determined from
wireless signals communicated between the mobile station
and the communication stations, and (b2) the multipath
information of (a2) for a collection of one or more of the
geographical locations; and

45 (iv) a fourth technique wherein said fourth technique uses a
statistical correlation for correlating (a) and (b) following:

- (a) wireless signal related values obtained from a
corresponding instance of said data, and
- 50 (b) information indicative of a location for the mobile station,
wherein said correlation is used for determining a value
indicative of a likelihood that the mobile station is within a
corresponding geographical area, and

(B) for said one or more of said techniques performed by said first location
estimator, said second location evaluator performs a different combination of
55 said one or more of said techniques when supplied with corresponding
instances of said data for the one or more techniques of said different
combination of techniques;

60 first obtaining, from said first location estimator, first location related
information, for said at least one occurrence, using a supplied first one or more
corresponding instances of said data for at least a time when said first one or more
corresponding instances are available;

65 second obtaining, from said second location evaluator, second location related
information, for said at least one occurrence, using a supplied second one or more
corresponding instances of said data for at least a time when said second one or more
corresponding instances are available;

wherein each of said first and second location related information is capable of
being obtained substantially independently from the obtaining of the other of said first
and second location related information;

70 determining a resulting location estimate of the mobile station dependent
upon at least one of: (a) a first value obtained from said first location related
information, and (b) a second value obtained from said second location related
information.

140. (Twice Amended) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and at least one of a plurality of terrestrial transceivers capable of wirelessly detecting said mobile station, comprising:

5 providing access to one or more of the location techniques (a) through (c) following:

10
C23
ant
(a) a first technique for triangulating or trilaterating a location of the mobile station, wherein for each of three or more of the communication stations, one of: a signal time of arrival, and a signal time difference of arrival between the mobile station and one of the transceivers is determined using a first input obtained from the wireless signal measurements, wherein the signals for obtaining the wireless signal measurements are received at the one transceiver

15 [communicated] during a plurality of wireless signal transmissions between the mobile station and the one transceiver, with at least one of the transmissions being from the mobile station to the one transceiver, and at least one of the transmissions being from the one transceiver to the mobile station;

20 (b) a second technique using a second input obtained from one or more transmissions between the mobile station and the transceivers, said second input including time delay measurements of signals received at the mobile station from one or more satellites;

25 (c) a third technique that determines a location of the mobile station by using a plurality of pairs of (i) and (ii) following:

(i) characteristics of wireless multipath signals communicated between some mobile station and one or more of the transceivers, and

(ii) a location of said some mobile station during the communication,

30

wherein when said third technique is supplied with a third input of characteristics of wireless multipath signals communicated between said mobile station and one or more of the transceivers, data indicative of a location of the mobile station is obtained from a similarity between the third input and the characteristics of wireless multipath signals of (c)(i);

35

determining whether a particular one of the location techniques (a) through (c) has its corresponding input available for determining a first location estimate of said mobile station;

40

determining a second location estimate of said mobile station by activating one of said location techniques different from said particular location technique when the corresponding input for said different technique is available.

142. (Twice Amended) A method for locating a mobile station using wireless signal measurements obtained from transmissions between the mobile station and at least one of a plurality of communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly communicating with the mobile station wirelessly, comprising:

providing access to at least first and second location estimators for estimating a location of the mobile station, wherein for said first location estimator to estimate a location of the mobile station, said first estimator is dependent upon a result from a first location technique included in one of the following (a) through (e) location technique categories, and for said second location estimator to estimate a location of the mobile station, said second estimator is dependent upon a result from a second component included in a different one of the following (a) through (e) location technique categories:

(a) one of a trilateration and a triangulation technique for determining a location estimate of the mobile station at a site not co-located with the mobile station, wherein for [each of] three or more of the communication stations in communication with the mobile station, one of: a wireless signal time of arrival, and a wireless signal time difference of arrival between the mobile station and the three or more communication stations is obtained using a first input obtained from timing measurements of the wireless signal measurements, wherein for at least one of the three or more communication stations, CS, the timing measurements are obtained from signals communicated during a plurality of wireless signal transmissions between the mobile station and CS, with at least one of the transmissions being from the mobile station to CS;

(b) a stochastic technique, wherein said stochastic technique uses a statistical correlation for correlating:

(i) a second input obtained from the wireless signal measurements, and

(ii) data indicative of a location area for the mobile station, wherein a probability that the mobile station is within the correlated location area is determined from said correlation;

(c) a learning technique, for learning an association, wherein said association is determined by a training process using a plurality of data pairs, each said pair including: first information indicative of a location of some mobile station, and second information from wireless signal measurements between said some mobile station and one or more of the communication stations when said some mobile station is at the location,

wherein when said learning technique is supplied with a third input obtained from the wireless signal measurements obtained from transmissions between the mobile station and at least one of a plurality of communication stations, data indicative of a location for the mobile station is determined;

(d) a pattern recognition location technique for estimating a location of the mobile station by recognizing a pattern of characteristics of a fourth input obtained from the wireless signal measurements, wherein said pattern of characteristics is indicative of multipath wireless signal transmissions between the mobile station and one or more of the communication stations; and

(e) a location technique using a fifth input obtained from measurements from signals received at the mobile station from one or more satellites;

determining whether said first location estimator has its corresponding input available for determining a first location estimate of the mobile station;

determining a second location estimate of said mobile station by activating said second location estimator when the corresponding input for said second location estimator is available, and said corresponding input to said first location estimator is

unavailable.

159. (Twice Amended) A method for locating a mobile station using wireless signal data obtained from transmissions between said mobile station and a plurality of communication stations capable of at least one of: wirelessly detecting said mobile station, and wirelessly being detected by said mobile station, wherein said communication stations are able to provide voice communication with the mobile station, comprising:

receiving said wireless signal data obtained from transmissions between said communication stations, and said mobile station at an unknown location, wherein said wireless signal data includes at least two of (A1) through (A3) following:

10 (A1) signal timing measurements of wireless signal transmissions between said mobile station and one or more of said communication stations at terrestrial locations, wherein for at least one of the communication stations CS, there is a corresponding portion of the signal timing measurements that are obtained during a plurality of wireless signal transmissions between the mobile station and CS, with at least one of the transmissions being from the mobile station to CS;

15 (A2) time delay measurements from wireless signal transmissions from one or more satellites to said mobile station, each of the satellites having one of the communication stations;

20 (A3) signal pattern characteristics of wireless signal transmissions between said mobile station and one or more of said communication stations, wherein said signal pattern characteristics are indicative of a multipath signal pattern at the unknown location between the mobile station and at least one of the communication stations;

25 generating one or more location estimates of said mobile station, using said wireless signal data, and at least two of the following location techniques (B1) through (B3) following:

30 (B1) a triangulation or trilateration technique using the measurements from (A1), said triangulation or trilateration technique performed at a site different from the unknown location of the mobile station;

25
J. J. J.

- (B2) a triangulation technique using the measurements from (A2);
(B3) a pattern recognition technique for estimating a location of said mobile station by recognizing a signal pattern of characteristics from (A3).
-

163. (Twice Amended) A mobile station location system, comprising:

an interface to one or more mobile station location estimators for estimating locations of mobile stations; such that for each of at least some of the mobile stations, when said one or more location estimators are supplied with corresponding data
5 obtained from measurements of wireless signals transmitted between the mobile station, and at least one of (1) and (2) following:

(1) a plurality of communication stations capable of at least one of:

wirelessly detecting said mobile stations, and being wirelessly detected by said mobile stations, and

(2) one or more non-terrestrial wireless signal transmitting stations,

then for said one or more location estimators supplied with their corresponding data, each such estimator outputs a corresponding location estimate of a geographical location of the mobile station;

wherein for a first of said mobile station location estimators, when estimating
15 a location of one of the mobile stations, said first estimator is dependent upon a result from a first component included in one of the following (a) through (f) component categories, and for a second of said mobile station location estimators, when estimating a location of one of the mobile stations, said second estimator is dependent upon a result from a second component included in a different one of the following
20 (a) through (f) component categories, wherein for at least one instance of locating one of the mobile stations, said first and second estimators provide different location estimates:

(a) a category of pattern recognition components, wherein each said pattern recognition component estimates a location of one of the mobile stations
25 from a pattern of multipath signal characteristics including a plurality of time delayed signal strengths of the wireless signal measurements provided by said corresponding data for said pattern recognition component;

(b) a category of trainable mobile station location estimating components for estimating a location of the mobile station, wherein each said trainable
30 mobile station location estimating component is capable of being trained to

associate: (i) each location of a plurality of geographical locations with (ii) corresponding measurements of wireless signals transmitted between some one of said mobile stations and the plurality of communication stations, wherein said some mobile station is approximately at the location;

35

(c) a category of locus computing components for estimating a location of the mobile station, each of said locus computing components outputting location estimates for a plurality of different mobile stations, wherein said locus computing components utilize timing measurements of wireless signals from their said corresponding data between the mobile station and two or more of the communication stations for determining a locus of locations for the mobile station, wherein said measurements are a function of a signal time delay between the mobile station and at least one communication station CS of the two or more communication stations, said communication station CS being attached to the ground, and wherein there is a corresponding portion of the signal timing measurements that are obtained during a plurality of wireless signal transmissions between the mobile station and CS, with at least one of the transmissions being from the mobile station to CS;

40

45

50

(d) a category of angle of arrival components for estimating a location of the mobile station, wherein each of said angle of arrival components determine a location estimate of the mobile station using a direction from which wireless signals arrive at at least one of the communication stations from the mobile station;

55

(e) a category of negative logic components for estimating an area of where the mobile station is unlikely to be located;

(f) a category of signal processing components for estimating a location of the mobile station using wireless signals received at the mobile station from the non-terrestrial transmitting stations, wherein said wireless signals provide time values, and said signal processing components determine at

60 least one differential between the time values for the wireless signals
transmitted by two of the non-terrestrial transmitting stations;
wherein said interface includes a component for communicating on a
communications network with at least one of said one or more location estimators and
thereby receiving, from said at least one estimator, said corresponding location
65 estimate of the mobile station; and
a resulting estimator for determining a likely location estimate of a particular
mobile station, said resulting estimator receiving one or more of said corresponding
location estimates for the particular mobile station from said interface, said resulting
estimator having at least one of: (i) a selector for identifying at least one preferred
70 location estimate from said corresponding location estimates, said likely location
estimate being at least as dependent on said preferred location estimate as any other of
said one or more corresponding location estimates, and (ii) a combiner for combining
said one or more corresponding location estimates for obtaining said likely location
estimate.

26
Conrad

2/2/98

169. (Twice Amended) A mobile station location system, comprising:
an interface to a plurality of mobile station location estimators for estimating
locations of mobile stations, such that for each of at least some of the mobile stations,
when one or more of said location estimators are supplied with corresponding data
5 obtained from measurements of wireless signals transmitted between:

- (i) the mobile station, and
- (ii) at least one of: a network of communication stations cooperatively
linked for use in locating the mobile stations, and one or more non-
terrestrial wireless signal transmitting stations,

27
10 then for said one or more location estimators supplied with their corresponding data,
each such estimator outputs a corresponding location estimate of a geographical
location of the mobile station;

wherein for a first of said mobile station location estimators, when estimating
a location of one of the mobile stations, said first estimator is dependent upon a result
15 from a first component included in one of the following (a) through (c) component
categories, and for a second of said mobile station location estimators, when
estimating a location of one of the mobile stations, said second estimator is dependent
upon a result from a second component included in a different one of the following
(a) through (c) component categories, wherein for at least one instance of locating one
20 of the mobile stations, said first and second estimators provide different location
estimates:

- (a) a category of pattern recognition components for estimating a
location of the mobile station from a pattern of wireless signal
characteristics including a plurality of time delayed signal strengths of the
25 wireless signal measurements provided by said corresponding data;
- (b) a category of triangulation components for estimating a location of
the mobile station, each of said triangulation computing components
outputting location estimates for a plurality of different mobile stations,
wherein said triangulation components utilize timing measurements of
30 wireless signals from their said corresponding data between the mobile

35 station and three of the communication stations for determining a location estimate of the mobile station, wherein said measurements are a function of a signal time delay between the mobile station and at least one communication station CS of the three communication stations, said communication station CS being attached to the ground, and wherein there is a corresponding portion of the signal timing measurements that are obtained during a plurality of wireless signal transmissions between the mobile station and CS, with at least one of the transmissions being from the mobile station to CS;

40 (c) a category of signal processing components for estimating a location of the mobile station using wireless signals received at the mobile station from the non-terrestrial transmitting stations, wherein said wireless signals provide time values, and said signal processing components determine at least one differential between the time values for the wireless signals transmitted by two of the non-terrestrial transmitting stations;

45 wherein said interface includes a component for communicating on a predetermined communications network for communicating with at least one of said first and second estimators and thereby receiving, from said at least one estimator, said corresponding location estimate of the mobile station; and

50 a resulting estimator for determining a likely location estimate of a particular mobile station, said resulting estimator receives one or more of said corresponding location estimates for the particular mobile station from said interface, said resulting estimator having at least one of: (i) a selector for selecting at least one preferred location estimate from said corresponding location estimates, said likely location estimate being at least as dependent on said preferred location estimate as any other of
55 said corresponding location estimates, and (ii) a combiner for combining said corresponding location estimates for obtaining said likely location estimate.

174. (Twice Amended) A method for locating a mobile station, comprising:

providing access to a plurality of mobile station location estimators for
estimating locations of mobile stations, such that for each of at least some of the
mobile stations, when one or more of said location estimators are supplied with
5 corresponding data obtained from measurements of wireless signals transmitted
between:

- (i) the mobile station, and
- (ii) at least one of: (1) a network of communication stations
cooperatively linked for use in locating the mobile stations, and (2)
10 one or more non-terrestrial wireless signal transmitting stations, ,

then said one or more location estimators each output corresponding location
estimates of a geographical location of the mobile station;

receiving a request for locating a particular one of the mobile stations;

first obtaining, from a first of said mobile station location estimators, a first
15 location estimate of the particular mobile station when said corresponding data for
said first estimator is input to said first estimator, said first estimator being dependent
upon a result from a first component included in one of the component categories (a)
through (e) following the step of second obtaining;

second obtaining from a second of said mobile station location estimators, a
20 second location estimate of the particular mobile station when said corresponding
data for said second estimator is input to said second estimator, said second estimator
being dependent upon a result from a second component included in a component
category (a) through (e) following different from said component category having
said first component, wherein for at least one instance of locating one of the mobile
25 stations, said first and second estimators provide different location estimates:

- (a) a category of pattern recognition components, wherein each said
pattern recognition component estimates a location of one of the
mobile stations from a pattern of multipath signal characteristics
including a plurality of time delayed signal strengths of the wireless

30

signal measurements provided by said corresponding data for said pattern recognition component;

35

(b) a category of trainable mobile station location estimating components for estimating a location of the mobile station, wherein each said trainable mobile station location estimating component is capable of being trained to associate: (i) each location of a plurality of geographical locations with (ii) corresponding measurements of wireless signals transmitted between some one of said mobile stations and the network of communication stations, wherein said some mobile station is approximately at the location;

40

(c) a category of triangulation components for estimating a location of the mobile station, each of said triangulation computing components being remotely located from the mobile station and outputting location estimates for a plurality of different mobile stations located remotely from the triangulation computing component, wherein said

45

triangulation components utilize timing measurements of wireless signals from their said corresponding data between the mobile station and three of the communication stations for determining a location estimate of the mobile station, wherein said measurements are a function of a signal time delay between the particular mobile station and at least one communication station CS of the three communication stations, said communication station CS being attached to the ground, and wherein there is a corresponding portion of the signal timing measurements that are obtained during a plurality of wireless signal transmissions between the mobile station and CS, with at least one of the transmissions being from the mobile station to CS;

50

55

(d) a category of angle of arrival components for estimating a location of said particular mobile station, wherein each of said angle of arrival components determine a location estimate of the mobile station using a

60 direction from which wireless signals arrive at at least one of the
communication stations from the mobile station;

65 (e) a category of signal processing components for estimating a
location of the mobile station using wireless signals received at the
mobile station from the non-terrestrial transmitting stations, wherein
said wireless signals provide time values, and said signal processing
components determine at least one differential between the time values
for the wireless signals transmitted by two of the non-terrestrial
transmitting stations;

70 generating a resulting location estimate of the particular mobile station, said
resulting location estimate being dependent upon an estimate of the particular mobile
station from at least one of said first and second mobile station location estimators
when said corresponding data for said at least one of the first and second estimators is
input to said at least one of the first and second estimators;

75 wherein said step of generating includes at least one of the substeps (i) and (ii)
following: (i) identifying at least one preferred location estimate from said first and
second location estimates, said resulting location estimate being at least as dependent
on said preferred location estimate as any other of said corresponding location
estimates obtained, and (ii) combining said first and second location estimates for
obtaining said resulting location estimate.